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(54) **PORT BASED DEFAULT VIRTUAL LOCAL AREA NETWORK**

PORTGESTÜTZTES STANDARDVIRTUELLES LOKALES NETZWERK

RESEAU LOCAL VIRTUEL PAR DEFAUT A POINTS D'ACCES

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(73) Proprietor: **CABLETRON SYSTEMS, INC.**
Rochester, NH 03867 (US)

(72) Inventor: **ITURRALDE, Carol, E.**
Framingham, MA 01701 (US)

(74) Representative: **Driver, Virginia Rozanne et al**
Page White & Farrer
54 Doughty Street
London WC1N 2LS (GB)

(56) References cited:

- **SAUNDERS S: "BUILDING VIRTUAL LANS ON A REAL-WORLD BUDGET LANART'S SEGWAY WORKS WITH ETHERNET SWITCHES TO DELIVER VIRTUAL LAN POWERS AT A LOW COST" DATA COMMUNICATIONS, vol. 24, no. 13, 21 September 1995, page 39/40 XP000526194**
- **"VIRTUAL LANS GET REAL ETHERNET SWITCH MAKERS ARE TAKING THE LEAD IN DEPLOYING VIRTUAL LANS ACROSS CAMPUS NETWORKS" DATA COMMUNICATIONS, vol. 24, no. 3, 1 March 1995, pages 87-92, 94, 96, 98, 100, XP000496027**
- **ANDERSEN J K: "VIRTUAL LANS TAKE NETWORK TO NEXT LEVEL" COMPUTER TECHNOLOGY REVIEW, vol. 16, no. 9, September 1996, page 12, 14 XP000642987**
- **MORENCY ET AL.: "VLANs: Can Layer 3 Save the Day" BUSINESS COMMUNICATIONS REVIEW, vol. 26, no. 12, December 1996, pages 47-50, XP002062190**
- **MCGIBBON: "Virtual LANs Come of Age" TELECOMMUNICATIONS (INTERNATIONAL EDITION), vol. 30, no. 6, June 1996, pages 48-52, XP002062191**

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EP 0 948 853 B1

Description

Field of the Invention

[0001] This invention generally relates to data transmission networks and, more particularly, to virtual local area networks.

Background of the Invention

[0002] A data network typically includes several nodes connected together by a data transport medium. One common method of transmitting data between the nodes is to break the data up into discrete "packets" of data. Packets can be transported over the medium by any one of a variety of transport techniques. In applications utilizing packetized data, data to be transported first is broken up into discrete packets of data, then transmitted through the network medium, and finally reassembled at a destination node. In accordance with current packet protocol, each packet generally comprises a header and an information field. The header contains the information used to transport the cell from one node to the next while the packet data is contained in the information field. Among other information in the header is the destination address of the data packet.

[0003] A local area network (i.e., "LAN") is a type of local data network commonly used in a single office or building. LANs are an efficient mechanism for maximizing use of network resources by members of the LAN. Simple LANs typically include two or more nodes (e.g., a server, computer, printer, or other resource) that are interconnected by a common physical connection such as, for example, a hub. Data switches also may be connected to the hub for directing data traffic and for connecting the LAN to other data networks.

[0004] LANs can be inconvenient and expensive to maintain. For example, moving a user to another location within a relatively large office building often requires that the LAN be rewired and reconfigured. This can be cumbersome and expensive. The art has responded to this problem by developing virtual local area networks (i.e., "VLANs").

[0005] For example, "Virtual LANs' Get Real", Data Communications vol. 24 no. 3, pp. 87-99, describes the general characteristics and considerations that should be taken when building a VLAN. As described in "Virtual LANs Get Real", a VLAN is generally defined as a group of nodes interconnected by software to form a single logical broadcast domain. VLANs may be connected to nodes that are members of any number of physical LAN segments. Among many advantages, VLANs enable network administrators to create logical groupings of users and network resources, thereby allowing remote users and resources to appear as if they are members of a single LAN. This enables companies and other organizations to build dynamic, flexible, and distributed LANs, thus simplifying physical moves of a user in a network.

By way of background, for example, a description of how a VLAN may be used to facilitate communication within a company may be found in "Virtual LANs Take Network to Next Level", Computer Technology Review, Vol. 16, no. 9, September 1996, page 12-14. Background information regarding VLANs may additionally be found in "VLANs" Can Layer 3 Save the Day?", Business Communications Review, Vol. 26, no. 12, December 1996, pages 47-50 and "Virtual LANs Come of Age", Telecommunications Vol. 30, no. 6, June 1996, pages 48-52.

[0006] Examples of virtual LAN networks are described in "Building Virtual LANs on a real-World Budget Lanart's Segway Works with Ethernet Switches to Deliver Virtual LANs Powers at a Low Cost", Data Communications, Vol. 24, no 13, pp. 39-40. The Segway system, described in Data Communications Vol. 24, no. 13, provides a twenty-four port module for coupling workstations to a LAN switch. Up to five of the modules may be interconnected to provide a virtual LAN of 120 network connections.

[0007] As described in the above references. VLANs may be formed by defining logical groups of users within the VLAN. One such VLAN, known as a "port-based" VLAN, defines the VLAN as a collection of switch ports on one or more switches across a hub. Users connected to those defined switch ports therefore are members of the defined VLAN. Broadcast messages directed to that VLAN may be transmitted through the defined switch ports only. Known port-based VLANs typically are implemented on a switch to include a default VLAN, in addition to other VLANs that may be formed on the switch. During manufacture, the default VLAN is defined as every port on a single switch. The number of switch ports defining the default VLAN decreases, however, as ports on the switch are used for defining other VLANs. Accordingly, on an exemplary eight-port switch having a first VLAN defined by ports one and two, the default VLAN will be defined by remaining ports three through eight.

[0008] However, port-based default VLANs may have data leakage problems that can compromise the security of data transmitted across the network. Specifically, port-based default VLANs transmit a data packet to every switch port when that packet is received by the default VLAN and is destined for a port that is not in the default VLAN. Continuing with the above example, a data packet received on a port defining the default VLAN (i.e., one of ports three through eight) and destined for another port also on the default VLAN will be transmitted to the destination port only. In the event that the data packet was destined for a port on the first VLAN (i.e., port one or two), however, the packet would be transmitted to all of the ports on the switch, thus creating the above mentioned security problem.

[0009] Accordingly, it would be desirable to provide a port-based default VLAN that prevents such leakage problems between VLANs. It is among the general objects of this invention to provide such a device and meth-

od.

Summary of The Invention

[0010] In accordance with the pnnciples of the invention, a port-based default VLAN is provided that prevents leakage problems across VLANs. To that end. the default VLAN includes means for transmitting data received by the default VLAN to ports defining the default VLAN only. No other ports on the switch will receive a data packet that was received on a port defining the default VLAN.

[0011] In accordance with another aspect of the invention, each of the ports on a plurality of switches connected to a hub are configured, during manufacture, to define a default VLAN spanning the plurality of switches. To that end, the default VLAN includes a bus in the hub, an enable switch for electrically connecting each of switches to the bus, and means for defining each of the switch ports as the default VLAN.

[0012] It is among the objects of the invention to provide port-based default VLAN and method that prevents leakage across the ports of a switch.

[0013] It is another object of the invention to provide a port-based default VLAN that, is configured, during manufacture, to span a plurality of switches connected to a hub.

Brief Description Of The Drawings

[0014] The above and further advantages of the invention may be better understood by referring to the following description in conjunction with the accompanying drawings and which:

Figure 1 is a block schematic diagram of a partial data network assembly for implementation of the invention;

Figure 2 is a block schematic diagram of a switch that forms a port-based, default VLAN;

Figure 3 is a schematic diagram of a data packet; and

Figure 4 is a flow chart that specifies the method used for preventing leakage from the default VLAN.

Detailed Description Of A Preferred Embodiment

[0015] Figure 1 shows a partial data network assembly 10 for implementation of the invention, comprising a hub 12 having hub ports 14, and switches 16 connected to the hub ports 14. The hub 12 may be a DEChub Multiswitch 900, available from Digital Equipment Corporation of Maynard, Massachusetts. Each of the switches 16 has a plurality of switch ports 18 (e.g., eight) connecting various network resources, such as servers, computers, and printers, to the network. A bus 20 spanning each of the hub ports 14 may be enabled by an enable switch 24 to interconnect each of the switches 16. This consequently interconnects each of the switch ports 18 across each of the interconnected switches 16. In the preferred embodiment, the bus 20 is enabled during manufacture, thus defining the default VLAN as all of the ports of the interconnected switches 16. The enable switch 24 may be implemented as firmware within the hub 12, or as a manually actuated switch on the hub 12.

[0016] New port-based VLANs may be formed across one or more of the switches 16 by selecting combinations of interconnected switch ports 18. Selected switch ports 18 for new VLANs consequently are removed from the default VLAN definition, thus reducing the size of the default VLAN. No data packets received on any one of the default VLAN ports may be transmitted to the ports that define other VLANs.

[0017] Figure 2 shows an exemplary eight port switch 16 forming a default VLAN, VLAN 2, and VLAN 3. Ports one and two define the default VLAN, ports three to five define VLAN 2, and ports six to eight define VLAN 3. Data packets received on switch ports one or two may be transmitted to either or both of those switch ports 18 only, thus preventing leakage to VLAN 2 and VLAN 3. For example, a data packet received on port two having a destination address of port four will be transmitted to both ports one and two only. Similarly, a data packet received on port two having a destination address of port one will be transmitted to port one only. VLAN 2 and VLAN 3 limit leakage in like fashion.

[0018] Figure 3 shows a data packet 26, comprising a header 28 and an information field 30. The destination address of the data packet 26 is stored in the header 28 of the data packet 26. The switch port 18 associated with the destination address is ascertained by conventional means within the switch 16 receiving the data packet 26. This information is used by the method shown in figure 4.

[0019] Figure 4 shows a flow chart that specifies the method used for preventing leakage from the default VLAN. More particularly, the destination port address is ascertained from the header 28 of a data packet received on one of the default VLAN ports (step 400). At step 402, it is determined if the destination port is one of the default VLAN ports. If the destination port is one of the default VLAN ports, that data packet is transmitted to the destination port only (step 404). If the destination port is not one of the default VLAN ports, the data packet is transmitted to all of the default VLAN ports only (step 406). The data packet is transmitted to no other switch ports 18.

[0020] The default VLAN may be assigned a default VLAN tag that is assigned to a data packet when it enters through one of the default VLAN ports. The switch 16 then may be configured to prevent transmission of any data packet, having an associated default VLAN tag, through any of the other, non-default VLAN ports.

[0021] The invention may be implemented by means of a programmable logic chip within the one or more

switches 16 used for the invention. The invention may also be implemented as firmware stored within those switches 16. Both implementations may be programmed by conventional methods.

[0022] In an alternative embodiment, the invention may be implemented as a computer program product for use with a computer system. Such implementation may include a series of computer instructions fixed either on a tangible medium, such as a computer readable media (e.g. diskette, CD-ROM, ROM, or fixed disk) or transmittable to a computer system, via a modem or other interface device, such as communications adapter connected to the network over a medium. The medium may be either a tangible medium (e.g., optical or analog communications lines) or a medium implemented with wireless techniques (e.g., microwave, infrared or other transmission techniques). The series of computer instructions embodies all or part of the functionality previously described herein with respect to the invention. Those skilled in the art should appreciate that such computer instructions can be written in a number of programming languages for use with many computer architectures or operating systems. Furthermore, such instructions may be stored in any memory device, such as semiconductor, magnetic, optical or other memory devices, and may be transmitted using any communications technology, such as optical, infrared, microwave, or other transmission technologies. It is expected that such a computer program product may be distributed as a removable media with accompanying printed or electronic documentation (e.g., shrink wrapped software), preloaded with a computer system (e.g., on system ROM or fixed disk), or distributed from a server or electronic bulletin board over a network (e.g., the Internet or World Wide Web).

[0023] The inventive default VLAN thus prevents leakage to other VLANs by transmitting received data packets to default VLAN ports only. Security thus is ensured for data packets transmitted to the default VLAN. Furthermore, the initial size and scope of the default VLAN is increased by enabling the enable switch 24, during manufacture, to interconnect each of the switches 16 connected to the hub 12.

[0024] While the invention has been shown and described above with respect to various preferred embodiments, it will be apparent that the foregoing and other changes of the form and detail may be made therein by one skilled in the art without departing from the scope of the invention. These and other obvious modifications are intended to be covered by the following claims.

Claims

1. A system to implement a port-based default VLAN formed on one or more interconnected networking switches (16), each switch (16) having one or more switch ports (18), all of the switch ports collectively being a plurality of switch ports, the default VLAN being defined by a first subset comprising one or more of the plurality of switch ports, the defined subset of the one or more of the plurality of switch ports being default VLAN ports, at least one of the plurality of switch ports not in the first subset of switch ports defining a second VLAN, the system comprising:

   means for receiving a data packet (26) through one of the default VLAN ports (1,2);
   means for ascertaining a destination port from the received data packet, the destination port being one of the plurality of switch ports;
   means for determining whether the destination port is one of the default VLAN ports:
   first means, responsive to the determining means, for transmitting the data packet to the destination port when the determining means determines that the destination port is one of the default VLAN ports; and
   second means, responsive to the determining means, for transmitting the data packet only to each of the other default VLAN ports when the determining means determines that the destination port is not one of the default VLAN ports.

   wherein the at least one switch port defining the second VLAN is free from receiving the data packet.

2. The system as defined by claim 1 wherein the data packet (26) includes a header (28) and the ascertaining means ascertains the destination port from the packet header.

3. The system as defined in claim 1 further including means for tagging the data packet as being in the default VLAN.

4. A method of limiting broadcast messages from a port-based default VLAN, the default VLAN formed on one or more interconnected networking switches (16), each switch having one or more switch ports (18), all of the switch ports collectively being a plurality of switch ports, the default VLAN being defined by a first subset comprising one or more of the plurality of switch ports, the defined first subset of one or more of the plurality of switch ports being default VLAN ports, at least one of the plurality of switch ports not in the first subset of switch ports defining a second VLAN, the method comprising:

   receiving a data packet through one of the default VLAN ports;
   ascertaining (400) a destination port from the data packet, the destination port being one of the plurality of switch ports;

determining (402) whether the ascertained destination port is one of the default VLAN ports;
transtnitting (404) the data packet to the destination port when the destination port is one of the default VLAN ports; and
only transmitting (406) the data packet to each of the other default VLAN ports when the destination port is not one of the default VLAN ports.

5. The method as defined by claim 4 further including:

tagging the data packet as being in the default VLAN.

6. A data network assembly (10) comprising:

a hub (12) having at least two networking switches (16) connected thereto, each switch having one or more switch ports (18);
a bus (20) in the hub;
an enable switch (24) to electrically connect each of the switch ports to the bus;
means for defining a subset of the switch ports as a default VLAN; and
means for transmitting packets received on one of the switch ports of the defined subset only to the other switch ports of the defined subset so as to prevent transmission to switch ports that are not in the default VLAN.

Patentansprüche

1. Portgestütztes Standard-VLAN, welches auf einem oder mehreren zusammen geschalteten Vernetzungs-Schaltern (16) ausgebildet ist, wobei jeder Schalter (16) einen oder mehrere Schalterer-Anschlüsse (18) aufweist, wobei sämtliche der Schalter-Anschlüsse gemeinsam eine Vielzahl von Schalter-Anschlüssen darstellen, wobei das Standard-VLAN definiert ist durch eine erste Teilmenge, welche einen oder mehrere der Vielzahl von Schalter-Anschlüssen umfasst, die bestimmte Teilmenge der einen oder mehreren der vielzahl von Schalter-Anschlüssen Standard-VLAN-Anschlüsse sind, zumindest eine der Vielzahl von Schalter-Anschlüssen, die nicht in der ersten Teilmenge von Schalter-Anschlüssen ist, definiert ein zweites VLAN, wobei das System Folgendes aufweist:

- Mittel zum Empfang eines Datenpaketes (26) über einen der Standard-VLAN-Anschlüsse (1,2);
- Mittel zur Ermittlung eines Zielanschlusses von dem empfangenen Datenpaket, wobei der Zielanschluss einer aus der Vielzahl von Schalter-Anschlüssen ist;
- Mittel zur Bestimmung ob der Zielanschluss einer der Standard-VLAN-Anschlüsse ist;
- Erstes Mittel, welches auf das Mittel zur Bestimmung anspricht zur Übermittlung des Datenpaketes an den Zielanschluss, wenn das Mittel zur Bestimmung festlegt, dass der Zielanschluss einer der Standard-VLAN-Anschlüsse ist; und
- Zweites Mittel, welches auf das Mittel zur Bestimmung anspricht, zur Übertragung des Datenpaketes lediglich zu jedem der anderen Standard-VLAN-Anschlüsse, wenn das Mittel zur Bestimmung festlegt, dass der Zielanschluss nicht einer der Standard-VLAN-Anschlüsse ist;
- worin der zumindest eine Schalter-Anschluss, der das zweite VLAN bestimmt, frei von einem Empfang des Datenpaketes ist.

2. Netzwerk nach Anspruch 1, worin das Datenpaket (26) ein Kopfteil (28) beinhaltet und das Mittel zur Bestimmung den Zielanschluss von dem Paketkopf ermittelt.

3. Netzwerk nach Anspruch 1, welches weiterhin ein Mittel zur Markierung des Datenpaketes als in dem Standard-VLAN vorhanden beinhaltet.

4. Verfahren zur Beschränkung allgemeiner Meldungen von einem portgestützten standard virtuellen lokalen Neztwerk (VLAN), wobei des Standard-VLAN auf einem oder mehreren zusammengeschalteten Vernetzungs-Schaltern (16) ausgebildet ist, jeder Schalter einen oder mehrere Schalter-Anschlüsse (18) aufweist, sämtliche der Schalter-Anschlüsse gemeinsam eine Vielzahl von Schalter-Anschlüssen sind, der Standard-VLAN definiert wird durch eine erste Teilmenge, die einen oder mehrere aus der Vielzahl von Schlater-Anschlüssen umfasst, die bestimmte erste Teilmenge des einen oder mehreren der Vielzahl von Schalter-Anschlüssen Standard-VLAN-Anschlüssse sind, zumindest einer aus der Vielzahl von Schalter-Anschlüssen, der nicht in der ersten Teilmenge von Schalteranschlüssen enthalten ist, ein zweites VLAN bestimmt und das Verfahren Folgendes aufweist:

- Empfangen eines Datenpaketes über einen der Standard-VLAN-Anschlüsse;
- Ermittlung (400) eines Zielanschlusses von dem Datenpaket, wobei der Zielanschluss einer aus der Vielzahl von Schalteranschlüssen ist;
- Bestimmung (402) ob der ermittelte Zielanschluss einer der Standard-VLAN-Anschlüsse ist;

- Übertragung (404) des Datenpaketes an den Zielanschluss, wenn der Zielanschluss einer der Standard-VLAN-Anschlüsse ist; und
- Übertragung (406) des Datenpaketes zu jedem der anderen Standard-VLAN-Anschlüsse, wenn der Zielanschluss nicht einer der Standard-VLAN-Anschlüsse ist.

5. Verfahren nach Anspruch 4, welches weiterhin aufweist: Markieren des Datenpaketes als in dem Standard-VLAN befindlich.

6. Netzwerkaufbau (10), welcher Folgendes aufweist:

- einen Hub (12) mit zumindest zwei damit verbundenen Vernetzungs-Schaltern (16), wobei jeder Schalter einen oder mehrere Anschlüsse (18) aufweist;
- einen Bus (20) in dem Hub;
- einen Freigabeschalter (24) zur elektrischen Verbindung eines jeden der Schalteranschlüsse mit dem Bus;
- Mittel zur Bestimmung einer Teilmenge von Schalteranschlüssen als ein Standard-VLAN ; und
- Mittel zur Übertragung von Paketen, die auf einem der Schalter-Anschlüsse der bestimmten Teilmenge empfangen werden, lediglich zu den anderen Schalter-Anschlüssen der bestimmten Teilmenge um eine Übertragung an Schalter-Anschlüsse zu verhindern, die sich nicht in dem Standard-VLAN befinden.

Revendications

1. Système pour mettre en oeuvre un VLAN par défaut à points d'accès formé sur un ou plusieurs commutateurs en réseau interconnectés (16), chaque commutateur (16) ayant un ou plusieurs points d'accès de commutateur (18), tous les points d'accès de commutateur formant collectivement une pluralité de points d'accès de commutateurs, le VLAN par défaut étant défini par un premier sous-ensemble comprenant un ou plusieurs de la pluralité de points d'accès de commutateur, le sous-ensemble défini d'un ou plusieurs de la pluralité de points d'accès de commutateur étant des accès de VLAN par défaut, au moins de la pluralité de points d'accès de commutateur ne faisant pas partie du premier sous-ensemble de points d'accès de commutateur définissant un second VLAN, le système comprenant :

des moyens pour recevoir un paquet de données (26) par l'intermédiaire de l'un des accès de VLAN par défaut (1, 2) ;
des moyens pour fixer un accès de destination à partir du paquet de données reçu, l'accès de destination étant l'un de la pluralité de points d'accès de commutateur ;
des moyens pour déterminer si l'accès de destination est l'un des accès de VLAN par défaut ;
des premiers moyens, agissant en réponse aux moyens de détermination, pour transmettre le paquet de données à l'accès de destination quand les moyens de détermination déterminent que l'accès de destination est l'un des accès de VLAN par défaut ; et
des seconds moyens, agissant en réponse aux moyens de détermination, pour transmettre le paquet de données seulement à chacun des autres accès de VLAN par défaut quand les moyens de détermination déterminent que l'accès de destination n'est pas l'un des accès de VLAN par défaut ;

dans lequel au moins un point d'accès de commutateur définissant le second VLAN est libre pour recevoir le paquet de données.

2. Système selon la revendication 1, dans lequel le paquet de données (26) comprend une entête (28) et les moyens de fixation fixent l'accès de destination à partir de l'entête de paquet.

3. Système selon la revendication 1, comprenant en outre des moyens pour étiqueter le paquet de données comme étant dans le VLAN par défaut.

4. Procédé pour limiter des messages d'émission à partir d'un VLAN par défaut à points d'accès, le VLAN par défaut étant formé d'un ou plusieurs commutateurs en réseau interconnectés (16), chaque commutateur comportant un ou plusieurs points d'accès de commutateur (18), tous les points d'accès de commutateur formant collectivement une pluralité de points d'accès de commutateur, le VLAN par défaut étant défini par un premier sous-ensemble comprenant un ou plusieurs de la pluralité de points d'accès de commutateur, le premier sous-ensemble défini d'un ou plusieurs de la pluralité de points d'accès de commutateur étant des accès de VLAN par défaut, au moins un de la pluralité de points d'accès de commutateur ne faisant pas partie du premier sous-ensemble de points d'accès de commutateur définissant un second VLAN, le procédé comprenant :

recevoir un paquet de données par l'intermédiaire de l'un des accès de VLAN par défaut ;
fixer (400) un accès de destination à partir du paquet de données, l'accès de destination étant l'un de la pluralité de points d'accès de commutateur ;
déterminer (402) si l'accès de destination fixé

est l'un des accès de VLAN par défaut ;
transmettre (404) le paquet de données à l'accès de destination quand l'accès de destination est l'un des accès de VLAN par défaut ; et
transmettre seulement (406) le paquet de données à chacun des autres accès de VLAN par défaut quand l'accès de destination n'est pas l'un des accès de VLAN par défaut.

5. Procédé selon la revendication 4, comprenant un étiquetage du paquet de données comme étant dans le VLAN par défaut.

6. Structure de réseau de données (10) comprenant :

un répartiteur (12) comprenant au moins deux commutateurs en réseau (16) qui lui sont connectés, chaque commutateur comprenant un ou plusieurs points d'accès de commutateur (18) ;
un bus (20) dans le répartiteur ;
un commutateur de validation (24) pour relier électriquement chacun des points d'accès de commutateur au bus ;
des moyens pour définir un sous-ensemble des points d'accès de commutateur en tant que VLAN par défaut ; et
des moyens pour transmettre des paquets reçus au niveau de l'un des points d'accès de commutateur du sous-ensemble défini seulement aux autres points d'accès de commutateur du sous-ensemble défini de façon à empêcher la transmission vers des points d'accès de commutateur qui ne sont pas dans le VLAN par défaut.

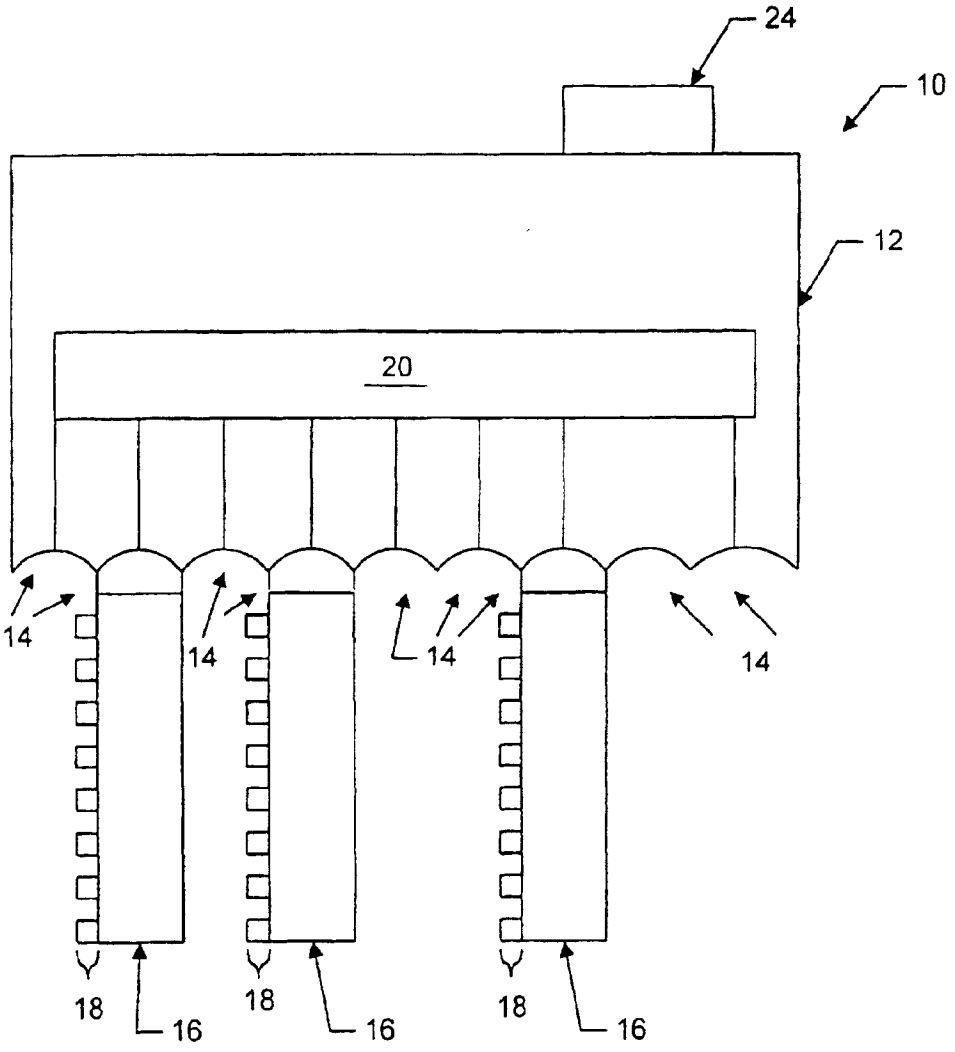

FIG. 1

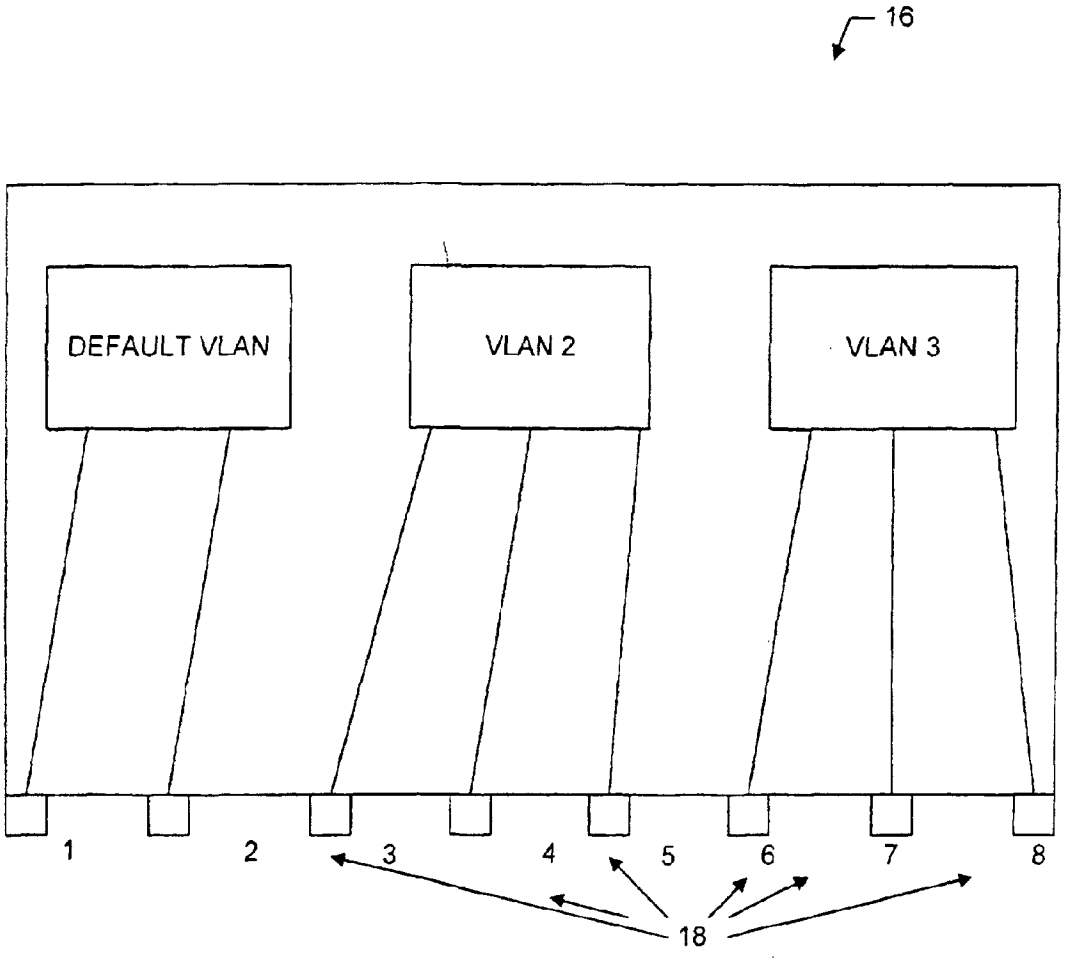

FIG. 2

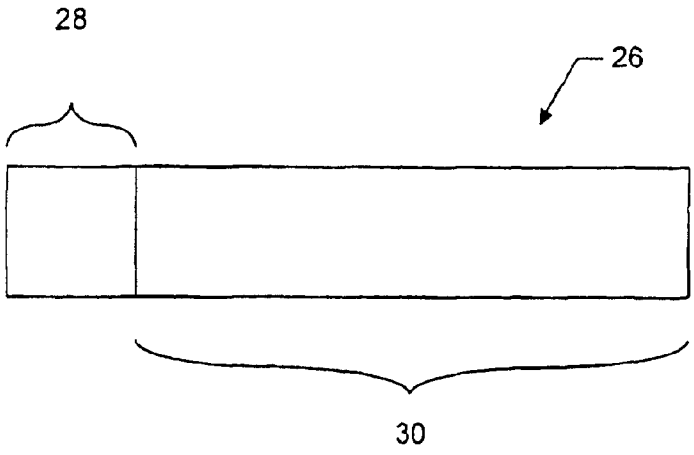

FIG. 3

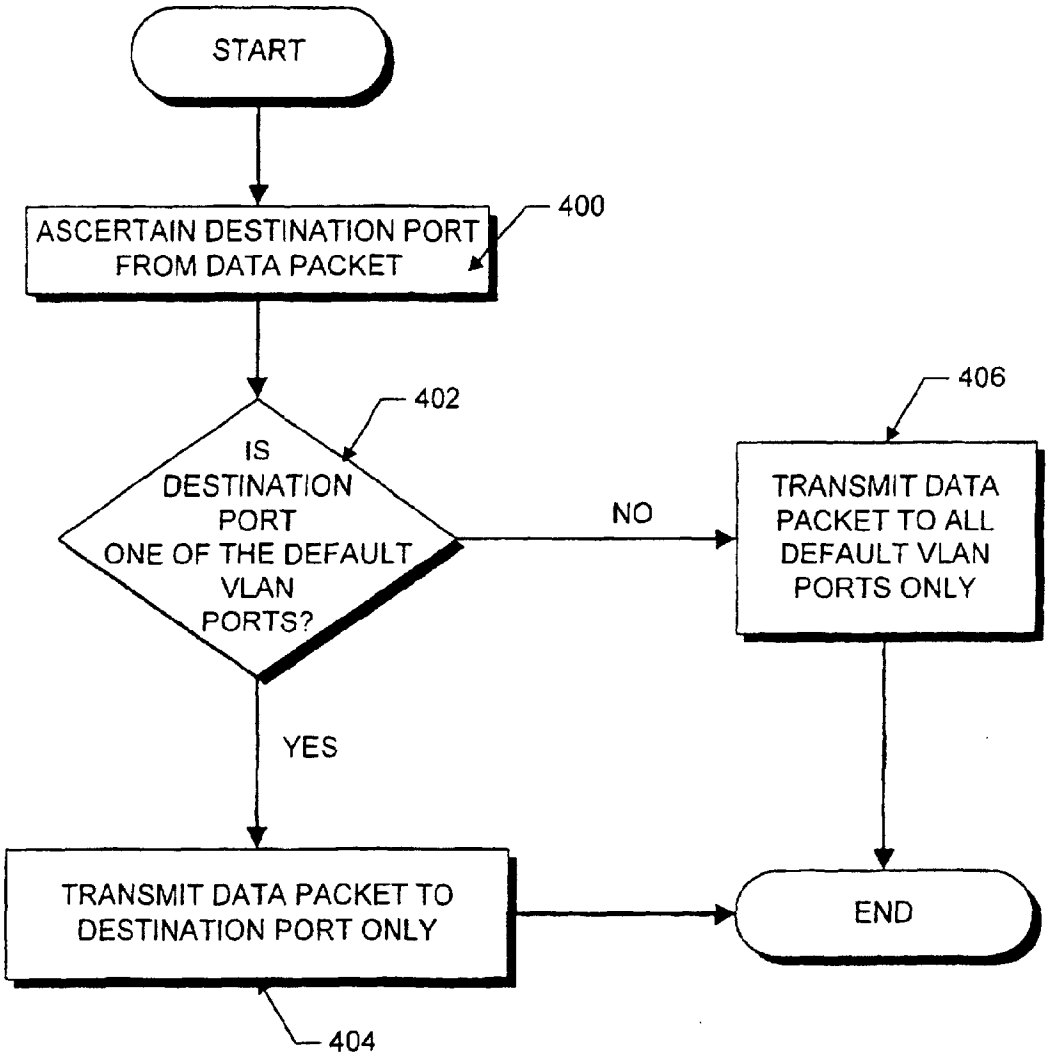
START
ASCERTAIN DESTINATION PORT FROM DATA PACKET
400
IS DESTINATION PORT ONE OF THE DEFAULT VLAN PORTS?
402
NO
YES
TRANSMIT DATA PACKET TO ALL DEFAULT VLAN PORTS ONLY
406
TRANSMIT DATA PACKET TO DESTINATION PORT ONLY
404
END

FIG. 4